

final desperation have said to themselves, "Well, now isn't this a case on which to test the therapeutic merits of 'phage?" This is a perfectly natural reaction, but is this the type of case on which to base such an inquiry? A sounder practice would seem to be to give alternate cases 'phage, and then compare the results with other forms of therapy.

(To be continued)

### TETANUS\*

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THE tetanus bacillus is widely distributed throughout the world, but is more common in certain districts than others. It is very common in the tropics and in some of the tropical islands, where the temperature remains constantly fairly high, and under these conditions appears to possess an increased virulence. It occurs normally in the intestines of herbivora and to a lesser extent of other animals and man. It is found in 15 per cent of horses around New York. For this reason highly cultivated manured districts frequently contain the bacilli and spores in large numbers. The spores are extremely resistant, both to heat and chemicals, and can retain their vitality for years in a dry condition. By means of an infected splinter, Henrijean reports a successful animal inoculation after eleven years. It produces exotoxins, tetanospasmin and tetanolysin, the former with a special affinity for nerve cells, probably related to their lipoidal contents, the latter of little pathological importance. Susceptibility in different animals varies enormously. The amount of toxin sufficient to kill a fowl will kill five hundred horses. Under natural conditions fowls do not contract the disease, while horses under their extreme susceptibility are especially liable to contract tetanus following any wound. Man is almost as susceptible as the horse, and to him 1/300 of a grain of the toxin is a fatal dose.

Deep, contused and badly lacerated wounds, especially if a foreign body is present, are favorable but by no means the invariable accompaniment of infection. I have seen more than one case develop through feet infected with chiggers. The bacilli tend to remain localized to the point of infection and there multiply moderately and produce their exotoxin, which is taken up by the end plates of the motor nerves and travels by the axis cylinder to the central nervous system. A few may be transported by leukocytes.

The incubation period varies within wide limits, roughly from five days to three weeks, usually from ten to fourteen days. That is the time taken for the toxin to travel from the point of infection to the central nervous system. Symptoms appear earlier in tropical countries, sometimes within a few hours. The shorter the incubation period the worse the prognosis.

### SYMPTOMS

The early symptoms are rather indefinite, but restlessness, irritability, insomnia, and sleep broken by terrifying dreams frequently occur. The existence of slight muscular rigidity or twitchings in the neighborhood of a suppurating wound should arouse suspicion and this is usually coupled with an exaggerated reflex response to gentle tapping of the muscles of the limb. Cases of local tetanus not infrequently occur on opening up and operating on old war injuries.

There may or may not be a peculiar grin, known as the risus sardonicus. The spasms spread to the trunk and limbs, which are exceedingly painful, violent, and exhausting, with only partial remissions; the patients usually remain quiet, probably from fear of provoking spasms. Fortunately the respiratory muscles are involved late. The slightest stimulus, *e. g.*, a draught, attempt at voluntary movement, or a banging door, is sufficient to throw the victim into violent spasms of a tonic character. The body is contorted and the respiration impeded with grunting and, indeed, muscles may be ruptured by the violence of the contractions on occasions.

A general rigidity, statuesque, is commonest in my experience, but an arching backwards of the spine (opisthotonus) is also common. Temperature usually runs from 101 to 103 degrees, but hyperpyrexia is not unusual. A moderate leukocytosis of 12,000 to 14,000 with a polymorphonuclear count of from 80 to 90 is the general rule. The unfortunate individual is only too conscious of his pitiable plight, shown by the look of terror which to me is almost characteristic. Death usually occurs in fatal cases in from three to five days from exhaustion.

**Prognosis.**—The prognosis is always serious. In cases in which symptoms show themselves under ten days it is about 40 per cent, but after three weeks it drops to about 15 per cent. Too often the disease is fully developed before treatment is commenced. Signs of bad prognostic import are hyperpyrexia, sleeplessness, strabismus, dysphagia, and respiratory involvement.

**Diagnosis.**—The most reliable test is to dilute some of the discharge from the deep parts of the wound with broth, divide it and inject one part into a susceptible animal, like a mouse or a guinea-pig, while the other is mixed with one cubic centimeter of tetanus antitoxin and injected into another animal. If the former develops tetanus while the latter escapes, there should be no doubt as to the diagnosis. Do not wait to establish a diagnosis in a doubtful case.

### TREATMENT

In treatment the first and most important factor is to give a prophylactic dose of 1500 units to every case where a wound or injury may be suspected of harboring the bacillus, such as blank cartridge wounds, and wounds likely to be contaminated with soil or manure. If there are reasonable grounds for suspicion this dosage should be repeated at the end of a week or ten days. Subcutaneously, antitoxin is absorbed

\* From the Holberton Hospital, Antigua, British West Indies.

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slowly; it takes about forty-eight hours to reach its maximum concentration.

It is recommended that 10,000 units at least be injected intrathecally at the earliest possible moment under anesthesia, and 10,000 units intramuscularly at the same time, in any patient who presents any definite symptoms. I regard anesthesia as essential in these cases. If there is no improvement in eighteen hours these doses should be repeated, and it is sometimes necessary to do this daily on three or four successive days. The volume of serum injected intrathecally should, of course, be rather less than the amount of cerebrospinal fluid drawn off and run in by gravity. In cases which respond to this treatment it is still wise to inject 10,000 units daily until the danger of relapse is passed, as shown by the absence of spasms and complete muscular relaxation. Intravenous administration is not recommended, as therapeutically it is inferior to the intrathecal method.

Treatment of wound, if present, is important and requires judgment, and I strongly recommend before any manipulative treatment is undertaken that an injection of 10,000 units should be given intramuscularly.

*Local Treatment.*—Amputation well above the site of infection, excision of the wound, or local irrigation with oxygenizing antiseptics, and, of course, efficient drainage, are methods which may be used, according to circumstances. Carrel's method is often very useful, using hydrogen peroxid, hypertonic saline, or Dakin's solution, etc. Of these I prefer hypertonic saline with sodium citrate. Symptomatic treatment consists in keeping the patient quiet in a darkened room and removing all sources of irritation or stimulation liable to provoke reflex spasms. Chloretone in twenty-five grain doses in olive oil per rectum was useful in reducing nervous excitability.

No cases of local tetanus came to the Holberton Hospital while I was there. It is simply tetanus occurring in a person insufficiently protected or immunized, and characterized by local spasm and rigidity of the muscles adjacent to the wound. It is very rare except in after-war injuries, where the antitoxin injected at the time of injury was insufficient to give full immunity. It may show itself weeks or months after the initial injury, usually after further operative interference. The affected muscles show rigidity and spasticity and differ only in degree from the major tetanus, except in one respect, and that is, the stiffness tends to persist sometimes for months. It is practically never fatal if properly treated. Tetanus does not appear to be very common in the United States of America. For the one hundred thousand admissions into the Los Angeles General Hospital between 1916 and 1923 there were seventy-two cases of tetanus, or one in fourteen hundred admissions.

Even with this proportion, taking the country as a whole, it is not a condition which we can afford to neglect.

Medico-Dental Building.

## RESUSCITATION OF THE NEWBORN : COMMENTS ON METHODS\*

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DISCUSSION by Dorothy A. Wood, M. D., San Francisco;  
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THE anesthetist as a member of an obstetrical unit, administering anesthetic agents to the mother, is increasingly called upon to aid in the resuscitation of the newborn, because of his familiarity with the apparatus and the gases used according to the newer conception of respiration.

Asphyxia neonatorum is the term applied to indicate an absence of breathing in the newborn. The circulation continues at birth, but there is an absence or failure of respiration, causing death. Respiration is initiated and regulated by the action of the blood gases, especially CO<sub>2</sub> on the respiratory center. Asphyxia results from interference with this gaseous exchange either before or after birth, through such causes as premature separation of the placenta, compression of the cord, delayed labor, the use of various drugs such as morphin, atelectasis of the lungs and intracranial injuries and pressure affecting the circulation of the respiratory center. Since varying degrees of intracranial congestion and the tendency to hemorrhage results from asphyxia, the method used in treating these infants often determines the outcome.

### MANUAL METHODS HARMFUL

The manual methods, positively harmful, are still widely used. Swinging the child by the feet or arms increases cerebral congestion and may cause hemorrhage. Vigorous rubbing of the skin or spanking often cause hemorrhage and injury to the internal organs, as does also the flexion and extension method of resuscitation. The immersion of the child alternately in ice water and in warm water dissipates heat and produces or adds to shock.

Mild cases of asphyxia respond often to the Sylvester method of artificial respiration, and to the "mouth to mouth" inflation of the infant's lungs, provided only gentle pressure is used. Vigorous inflation causes emphysema. Drugs are valueless in asphyxia as respiratory stimulants. Adrenalin into the heart muscle may help to bolster a failing circulation pending the effective use of carbon dioxid and oxygen.

Commonly in the newborn, and particularly in the premature infant, more or less extensive areas of atelectasis are present in the lungs. The circulation is deficient in both carbon dioxid and oxygen and the respiratory center remains inactive or respiration is feeble and irregular.

### CARBON DIOXID PROCEDURE

The physiological stimulant of the respiratory center is carbon dioxid. Given with oxygen which is essential to the vitality of the center and to the body metabolism, in mixtures of 5 per cent carbon dioxid and 95 per cent oxygen, we

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